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NOTES ON GEOGRAPHIC DISTRIBUTION

First record of *Pterygoplichthys ambrosettii* (Holmberg, 1893) (Siluriformes, Loricariidae) in the Mucuri river basin, Brazil

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Abstract. *Pterygoplichthys ambrosettii* (Holmberg, 1893) is indigenous to the middle/lower Paraná basin and has been intentionally introduced to several continents, including North America, Asia and Europe. In Brazil, the presence of allochthonous *P. ambrosettii* has been documented in the Upper portion of Paraná River, São Francisco River, and Doce River. This study aims to report the first documented occurrence of *P. ambrosettii* in the Mucuri river basin, located in the municipality of Mucuri, Bahia, Brazil.

Key words. Aquarium-trade, geographical distribution, Neotropical fishes, range expansion, species introduction

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INTRODUCTION

The tribe Hypostomini consists of two genera found in the Neotropical region, namely *Pterygoplichthys* Gill, 1858, and *Hypostomus* Lacepède, 1803 (Lujan et al. 2015). Species of *Pterygoplichthys* exhibits over seven dorsal-fin rays, and a small interopercle, which is connected to the hyomandibula. Additionally, this genus displays fewer vertebrae (8–11) from the dorsal fin to the hypural bone (Armbruster 2004). Currently, *Pterygoplichthys* has 16 valid species (Fricke et al. 2024), one of which is *Pterygoplichthys ambrosettii* (Holmberg, 1893). This species was originally described to the Paraguay River at Formosa County, Argentina (Holmberg 1893). The species is indigenous to the middle and lower portions of Paraná river basin, as well as the Paraguay and Uruguay river basins (Graça and Pavanelli 2007).

Pterygoplichthys species are commonly utilized in the aquarium trade, mainly due to their algae-scraping ability (Chavez et al. 2006). This skill aids in the maintenance and cleanliness of the aquariums. As a result of the aquarium trade, *Pterygoplichthys* has been introduced to various continents, leading to a myriad of impacts. They compete with native species for resources and space, can prey on benthic species' eggs, and cause structural changes on rivers (Orfinger and Goodding 2018).

The genus is currently found in North America including *P. ambrosettii*, *P. disjunctivus* (Weber, 1991), *P. gibbiceps* (Kner, 1854), and *P. pardalis* (Castelnau, 1855) (Nico and Martin 2001; Wakida-Kusunoki et al. 2007; Nico et al. 2012), as well as in Asia (*P. disjunctivus* and *P. pardalis*; Chavez et al. 2006; Wu et al. 2011), Africa (*P. disjunctivus*; Orfinger and Goodding 2018), and Europe (*P. pardalis*; Simonović et al. 2010). In Brazil, two species of *Pterygoplichthys* can be observed beyond their indigenous geographic distribution, namely *Pterygoplichthys joselimaianus* (Weber, 1991) and *P. ambrosettii*. The native distribution of *P. joselimaianus* is the Tocantins–Araguaia river basin, and its presence has only been recorded in the São Simão reservoir, located in the Paranaíba River, one of the main tributaries of the Upper Paraná basin (Sanches et al. 2014). The presence of *P. ambrosettii* has been documented along the Upper Paraná river basin as a result of the construction of the Itaipu Dam (Júlio Jr. et al. 2009), and this species has reached the headwaters of Sorocaba River, a tributary of Tietê drainage (Biagioni et al. 2013). This species was also recorded in São Francisco and Doce river basins (Frederico et al. 2019; Bueno et al. 2021).

The Mucuri river basin encompasses the aquatic ecoregion referred to as the "Northwestern Mata Atlântica" (Abell et al. 2008), and it shares fish species with other coastal drainages in Brazil, notably the

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Doce River (Camelier and Zanata 2014). The fish fauna of the Mucuri River is relatively well documented, with taxonomic (e.g. Sarmento-Soares and Martins-Pinheiro 2013; Pereira and Reis 2017; Pereira et al. 2018) and ecological studies (e.g. Pompeu and Martinez 2006, 2007; Bueno et al. 2021) having been undertaken. There were 54 native fish species recorded in the Mucuri River (Pompeu 2009), and 13 non-native species (Bueno et al. 2021). Within the Mururi river basin, no evidence of *P. ambrosettii* has been documented among the non-native species. Consequently, we present here for the first time the existence of *P. ambrosettii* in the Mucuri river basin and discuss the possible causes and implications of its introduction.

METHODS

The specimen of *Pterygoplichthys ambrosettii* was collected from the fish-passage of the Santa Clara hydroelectric dam, which is in the lower Mucuri river basin (Figure 1). The collection was made between November 2022 and February 2023, which corresponds to the wet season in the region. The Santa Clara fish passage consists of an elevator and a truck equipped with a tank. Six times a day, the team transports the fish caught by the elevator. The equipment operates throughout the duration of the 120-day period, during which non-native species are removed and subsequently euthanized with a lethal dose of eugenol and fixed in 10% formalin solution before being preserved in ethanol 70%. The voucher specimen was deposited in the fish collection at the Museu de Ciências Naturais at Pontifícia Universidade Católica de Minas Gerais, Brazil (MCNIP). The identification was made using the specialized key provided by Armbruster and Page (2006) and measurements of the individual were taken following Weber (1985).

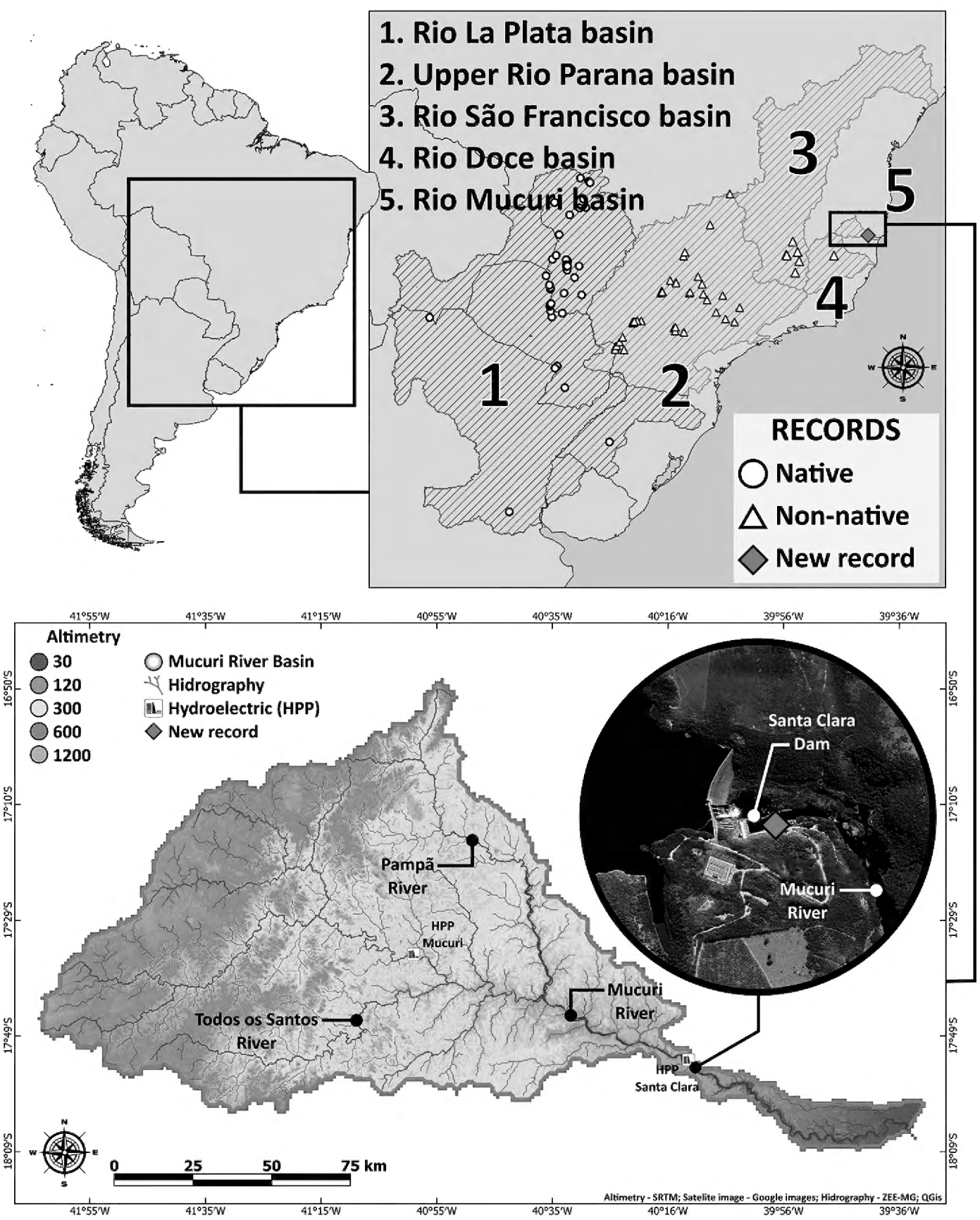

Figure 1. Native and non-native distribution range of *Pterygoplichthys ambrosettii* in Brazil, and the newly record in the of Mucuri river basin.

RESULTS

***Pterygoplichthys ambrosettii* (Holmberg, 1893)**
Figure 2

New record. BRAZIL (Mucuri river basin) – Bahia • Mucuri county, fish-passage facilities of the Santa Clara hydroelectric plant; 17°53′47″S, 040°12′01″W; elev. 52 m; 20.I.2023; G.N. Salvador, G.R. Rosa, M.L.A. Santos & G.M. Santos leg.; 1 specimen in ethanol, sex indet., MCNIP 4969.

Identification. The specimen recorded was identified as *P. ambrosettii* due to the following traits: absence of a crest on the nuchal region; single-shaped buccal papilla; lack of hypertrophied odontoids in the eversible cheek plates; presence of light spots on a dark background on the body, and a complex network of light and dark vermiculations on the abdomen area. The measurements are presented in the Table 1.

DISCUSSION

As previously mentioned, *Pterygoplichthys ambrosettii* is indigenous to middle and lower Paraná, Paraguay, and Uruguay river basins (Graça and Pavanelli 2007). In recent years, there has been a translocation of *P. ambrosettii* to various Brazilian basins, which has resulted in an expansion of this species' environmental niche range (Frederico et al. 2019). The species was first observed outside its original range in Brazil in 1997, specifically in the Upper Paraná River (da Silva et al. 2022). This can be attributed to the construction of the Itaipú reservoir, which inundated the Sete Quedas Falls, which were a natural barrier for multiple fish species, including *P. ambrosettii* (Graça and Pavanelli 2007). Since the 2010s, the species has been documented in the basins of the rivers São Francisco (Frederico et al. 2019), Doce (Bueno et al. 2021), and Mucuri (present study).

According to Bueno et al. (2021), the aquarium trade has been identified as the primary means by which *P. ambrosettii* was introduced. It is our belief that this trade also served as the means by which *P. ambrosettii* was introduced to the Mucuri river basin. Once *P. ambrosettii* reaches a considerable size, they are regarded as unwanted and discarded into the environment (Magalhães et al. 2017). An alternative possibility would be dispersal from the Doce river basin. Species of *Pterygoplichthys* are salinity tolerant (Brion et al. 2013), and the presence of the species in brackish waters has been documented already in the Philippines (Chavez et al. 2006). However, the salt concentration in the coastal area of the Doce river mouth surpasses the amount tolerated by *P. ambrosettii* (Brion et al. 2013; Simões et al. 2019). Despite this, this region possesses an abundance of small drainages, lagunas and channels, which may have lower salt concentrations which could facilitate the dispersion of *P. ambrosettii* towards the Mucuri River.

Despite the species being recorded only once, we maintain the belief that it has already become established in the Mucuri river basin. The reason behind this is the frequent capture of this species by fishermen in the lower part of the Mucuri River (GNS pers. obs.). This could potentially indicate that the species has successfully overcome the barrier of establishment and is now capable of reproducing in the new environment. However, we lack any evidence suggesting that *P. ambrosettii* surpassed the following barriers—as identified by Blackburn et al. (2011)—such as widespread dispersion throughout the basin and

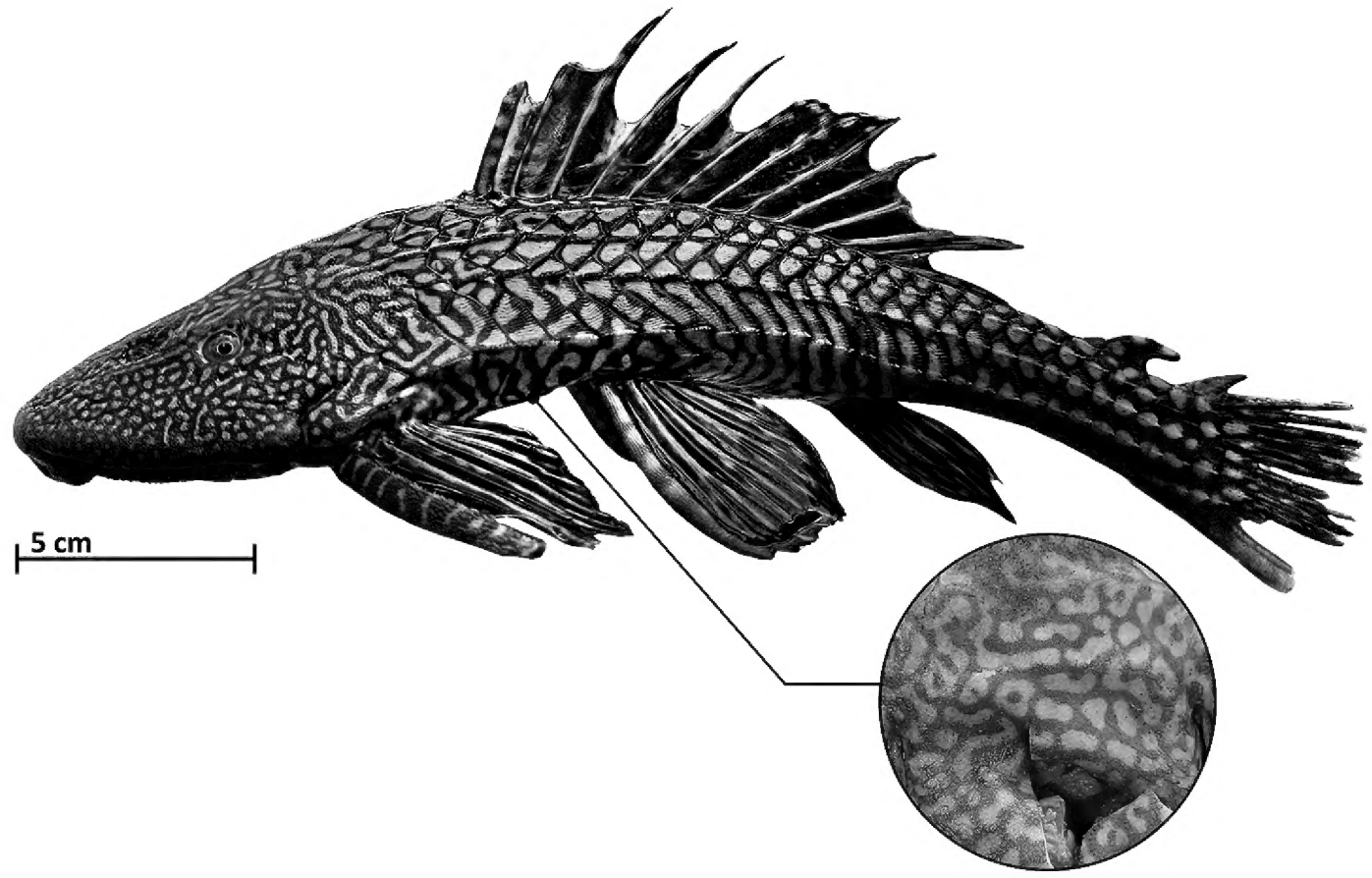

Figure 2. Live specimen of *Pterygoplichthys ambrosettii* (MCNIP 4969, 264 mm SL) collected in the Mucuri River, Mucuri County, Bahia, Brazil, and its ventral view detail after fixation.

Table 1. Counts and morphometric measurements of the specimen of *Pterygoplichthys ambrosettii* caught in the Mucuri River.

Type		**Ind. I**
Counts	Pectoral	I+5
	Pelvic	I+5
	Dorsal	I+12
	Anal	I+4
	Caudal*	I+13+I
Measurements (mm)	Standard length	264.0
	Total length*	286.0
	Pre-dorsal length	109.0
	Head length	85.0
	Cleithral width	71.0
	Head depth	52.0
	Snout length	43.0
	Orbital diamenter	9.0
	Iterorbital width	37.0
	Dorsal-fin spine length spine*	26.0
	Dorsal-fin base length	99.0
	Interdorsal length	34.0
	Thoracic length along median line	63.0
	Length of pectoral spine	79.0
	Abdominal length along median line	53.0
	Length of first pelvic ray	53.0
	Post-anal peduncular length	76.0
	Caudal peduncule depth	22.0

*Measurements that must be considered with caution due to the condition of the specimen.

the generation of adverse environmental and economic consequences, given that our observation occurred in the exact area reported by the fishermen.

The establishment of *Pterygoplichthys* species can be facilitated by factors such as their ability to inhabit degraded rivers and their higher fecundity rates when compared with other locirariid species (Mazzoni and Caramaschi 1997; Gibbs et al. 2008; Frederico et al. 2019). Competition with native algae-grazers and predation on bottom-attached eggs are likely the first impacts caused by this species (Capps and Flecker 2015). The affect is that *Pterygoplichthys* species can cause a decline in indigenous species populations, leading to economic losses in the fisheries sector, thereby affecting capital and livelihood (Orfinger and Goodding 2018). Although certain species of Loricariidae exhibit significant dietary variation (Salvador Jr. et al. 2009), the competition for food has the potential to impact some of the locriariid species in the Mucuri River, including *Hypostomus* spp., *Pogonopoma wertheimeri* (Steindachner, 1867), and *Delturus angulicauda* (Steindachner, 1877). Other fish species in the Mucuri River may also face competition for limited feeding resources, including the endangered *Prochilodus vimboides* (Kner, 1859) (Alves et al. 2021). The predation of bottom-attached eggs can impact species that engage in parental care, including species of Loricariidae and Cichlidae. This effect has already been observed in fish species in Thailand (Chaichana et al. 2013). The presence of *Pterygoplichthys* species can also result in structural consequences on rivers (Orfinger and Goodding 2018), including siltation and reduction of the river depth, which have a direct impact on nektonic species. This impact can have an indirect effect on two endemic and endangered species from the Mucuri river: *Brycon ferox* (Steindachner, 1877) and *Brycon vermelha* Lima & Castro, 2000 (Pompeu 2009; Lima 2017; ICMBio 2018).

The existing data demonstrate a significant range expansion of *P. ambrosettii* within Brazilian rivers, raising an important alarm. Notwithstanding the rapid dispersal caused by human activity, there is a limited body of research on the impact of this species on native fish populations in Brazilian waterways. The monitoring programs implemented by the hydroelectric plant could offer valuable data for comprehending these interactions and impacts. Nevertheless, it is crucial that (i) monitoring should span several years, (ii) hydroelectric companies grant access to the data for the purposes of publishing, and (iii) data collection is conducted with great care by the specialist consultants, with special attention given to the taxonomy of the species. These types of data can assess the impact of the introduction of *P. ambrosettii* on the native fish fauna; however, further investigation is needed to understand the species' effects on the new environment. A successful execution of this task requires a substantial allocation of resources towards improving

environmental quality, with a primary focus on data from the hydrologic and abiotic features of the river, such as substrate composition, waterproofing capacity, and the width of the channel during wet conditions. To prevent fish escape incidents by hobby aquarists, we propose a campaign among aquarium shops in urban areas aimed at raising awareness about the problems associated with releasing *Pterygoplichthys* species into rivers.

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ADDITIONAL INFORMATION

Conflict of interest

The authors declare that no competing interests exist.

Ethical statement

No ethical statement is reported.

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Authors' Contributions

Conceptualization: GNS, GRR, MLAS. Data curation: GNS, GRR, MLAS, GMS. Formal analysis: GNS, RGF. Funding acquisition: GRR, GMS. Investigation: GNS, GRR, MLAS. Methodology: GNS, RGF, GRR, MLAS, GMS. Project administration: GRR. Validation: GNS, RGF. Writing – original draft: GNS, GRR, RGF. Writing – review and editing: GNS, RGF, GRR, MLAS, GMS.

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Data availability

The supporting data for the findings of this study can be found in the main text.

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